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EXPLORING THE ATTRIBUTES AND KPI'S ADOPTED BY INTERNATIONAL HEALTHCARE PROVIDERS TO MEASURE THE PERFORMANCE OF THEIR ESTATES AT THE STRATEGIC LEVEL

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The requirements to improve the healthcare estate driven by changes in government priorities, the evolving healthcare agenda, and ever tightening budgets are asking estate managers to question what a good health estate looks like. It is crucial to develop a framework that supports providers to define the optimum performance of their estates needed to achieve best value, and ensure it reflects best practice. In this research the estate performance measurement and monitoring approaches for nine international healthcare organisations are reviewed, to identify the attributes and key performance indicators (KPIs) that are currently in use and to assess whether they can form the baseline for the approach to developing the framework. The findings show that each organisation employs a list of KPIs that are aligned and tailored to their contextual priorities and policies. Despite the differences between them, the research reveals that there is a common set of attributes and KPIs that are applied by the majority of the healthcare organisations reviewed. The next step of the research seeks to widen the sample and explore the rationale for this through a pan EU survey and focus groups.

Keywords: facilities management, healthcare estate, key performance indicators, performance measurement

INTRODUCTION

During the last few decades healthcare organisations have recognised the importance of making the best use of resources and expensive assets such as healthcare estates. The NHS in Scotland places special focus on increasing estate performance through the reduction of maintenance backlog, but also by seeking to reduce the number of underperforming, excess and underutilised facilities, thus ensuring buildings retain functionality and flexibility even within an increasingly ageing estate. These combine to affect the overall performance of the estate, and as healthcare budgets become increasingly constrained and contested it is critical to make the right decisions on how and where to allocate the resources to achieve best value. This, together with the shift to new models of care, the increasing demand for improving quality and the growing interest in patient satisfaction has brought up a debate in Health Facilities Scotland

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(HFS) about what performance attributes of estate and facilities services need to be measured and monitored as a basis for strategic decision making in order to improve the value which is delivered.

This paper presents the first phase of a collaborative research project with HFS which attempts to establish if there is a common set of performance attributes which healthcare providers need to measure and monitor in order to inform their management of the estate. The main project aims to establish a framework that supports healthcare providers to define the optimum performance at which their estates deliver best value reflective of their own contexts, thus reflecting organisation goals, stakeholder values and to deliver better healthcare for patients. The resulting framework will provide healthcare organisations with a reliable tool for strategic decision making, planning and resource allocation. Presented are the findings of a comparison of the attributes and KPIs adopted for performance measuring and monitoring by a selected group of nine international healthcare organisations revealing a common set of attributes but also identifying contextual differences. The findings from this first phase provide the foundation for phases 2, 3 and 4 which will be outlined and undertaken during the next two years.

Clarifying the terminology

In the context of healthcare when it comes to asset performance it mostly refers to physical assets which include land, building, medical equipment, fleet, IT & software; whereas 'estate' refers to the assets relating to land and building. This research is limited to estate assets and facilities services (laundry and linen, pottering, catering and cleaning), as the inclusion of all the physical assets into the future planned framework would generate an excess of data that can lead to confusion for the context of improving the performance of the estate; and considering also that in practice this is the way HFS define their performance monitoring framework. For the intention of this paper, when talking about estate, it refers to land, building and facility services.

Best value is understood to reflect the best use of the estate before its absolute need for replacement whilst delivering a better healthcare and achieve organisational goals.

Estate performance measurement and monitoring

Performance measurement provides the basis for an organisation to assess how well they are progressing towards their predetermined objectives, helping to identify areas of strengths and weaknesses, and support in the allocation of resources with the goal of improving organisational performance (Purbey *et al*., 2007; Amaratunga and Baldry, 2002). Different tools for assessing facilities performance are offered in the literature including post occupancy evaluation, performance measurement systems based on KPIs, the balance scorecard, facility performance evaluation, etc. Performance measurement systems based on KPIs provide the focus for this first phase of the research, as these KPIs are performance measures tightly linked to an organisation's strategy (Fitzgerald *et al*., 1991), provide a wider coverage of scope, inform decision makers about where to best focus resources to support performance, and they are the preference for HFS. A later phase of the research will review and analyse on the themes and measures provided in the other tools such as Post Occupancy Evaluation (POE), and facility/building performance evaluation.

Previous studies

The review of the literature reveals that there is extensive research conducted into facility performance management. Hinks and McNay (1999) classified a list of 172

KPIs under eight categories: business benefits, equipment, space, environment, change, maintenance/services, consultancy, and general. Meng and Minogue (2011) identified the ten most important performance indicators for facilities management, including cost -effectiveness, response time, service reliability, health, safety, environmental compliance, staff commitment, client-service provider relationship and IT application. However, research considering the link between facility performance management and its measurement and monitoring is less mature. Brackertz (2004) developed a performance measurement tool for facilities in local governments that consists of six perspectives: service, physical, community, financial, utilisation and environment. In another study Lavy *et al*., (2010) presented a literature-based list of categorised KPIs that covers the assessment of facility performance, breaking down the KPIs into four major categories: financial, physical, functional, and survey-based. Shohet *et al*., (2014) reduced the list to seven core KPIs for facility's performance assessment, including maintenance efficiency, replacement efficiency, condition index, functional index, indoor/outdoor environmental quality, absenteeism and user perception.

Talib *et al*., (2013) identified 11 areas for assessing the buildings performance distributed among three categories: functionality (design, utility, access), impact (outlook, core activities, facility, future design) and quality (building, engineering, performance, energy). To date, only limited research has explored performance measurement for healthcare build facilities, with Pullen *et al*., (2000) exploring seven key performance indicators (KPIs) applied in Australian hospitals but these were all business oriented and none related to the physical performance of the estate. Shohet (2006) proposed an integrated model formed by 11 key performance indicators for monitoring the performance, maintenance and cost effectiveness of hospital facilities. Building on this, Lavy and Shohet (2007) designed an Integrated Healthcare Facility Management Model established through an integrated analysis of key performance indicators which integrate the strategic and tactical decision making process on the life cycle perspective. Steinke *et al*., (2010) developed a building performance evaluation methodology by looking at healthcare facilities from the service, functional, physical and financial performance perspectives. Besides these studies, the authors believe that there is room for improvement and seek to offer a list of performance attributes and more practical set of indicators based on international best practices, relying on performance measurement and monitoring approaches that are currently in use.

METHODOLOGY

This research aims to provide a better understanding of the landscape of performance measurement in healthcare estates from a strategic perspective by reviewing and comparing the performance measurement and monitoring approaches adopted by nine public healthcare organisations to identify the similarities, differences and gaps. The review sought to compile an initial list of estate performance attributes and core KPIs that are practical and currently in use by international public healthcare organisations emerging from this comparison. The results presented from this first phase provide a point of departure for the second phase which seeks to widen the sample through a Pan EU survey of healthcare providers. The third phase will involve the design and hold of a series of workshops with experienced stakeholders and follow up interviews to establish the final framework that will be validated in the phase 4 with HFS and other organisations.

This research takes an exploratory approach to knowledge-building with a view to allowing the researchers to observe similarities and gather relevant data that will help shape the later phases. For this research, a review of the estates and facility performance management systems of nine healthcare organisations were examined to identify the performance measurement and monitoring approaches adopted, followed by the identification of the performance measures and KPIs within the approaches, and the subsequent analysis of the attributes of the estate they represent with a view to establish a list of common performance areas called 'attributes' for the purpose of this project.

Healthcare organisations were selected based on availability and access to information including: NHS in England, Scotland and Wales, Health and Human Services (HHS) in United States, Health Agency in New South Wales (Australia), Health Department in New Zealand, Queensland Health (Australia), the Spanish healthcare system and Province of Ontario (Canada). Qualitative data was collected through discussions and clarifications with key professionals drawn from HFS's network of international contacts; and an extensive grey literature search and review of government policies, guidelines, frameworks and strategies regarding asset and facility management and performance measurement.

Each document was evaluated to answer a set of questions that evolved during the initial stages of the research:

15. Has the organisation adopted any approach to measure and monitor the performance of the estates?
16. What characteristics of the estate are assessed and monitored, and what are the drivers?
17. What performance measures and KPIs are used?

In the study, the context of the performance measures and KPIs within and for each healthcare organisation was conducted with a view to understanding their strategies, funding, policy drivers, etc. The KPIs identified across the organisations were rationalised according to what they represented following the classification proposed by Lavy *et al*., (2010): financial, physical, functional and survey-based (in this context named 'patient experience'). Because not all of the groups fall under one of the four categories the authors added three more categories emerging from the analysis: 'safety', 'environment' and 'others'. Other categorisations could have been taken based on the domains observed in the performance measurement and monitoring frameworks; however, the authors considered this classification as the most appropriate as it is not influenced by the individual organisation' strategies and policies, appearing to be common to all healthcare providers. A total of 27 characteristics were obtained and sorted into the 7 overarching categories.

Data collected was presented in the form of excel spreadsheets to allow for comparisons and to identify the similarities and gaps. Each KPI was properly defined and their applicability analysed in the context of the country where they were used and reflective drivers. For this paper, this work was summarised and presented in a more compressed form.

The initial comparison was hampered by the lower than anticipated levels of transparency and participation from the healthcare organisations across the world. In addition, the lack of definitions and unclear terminology offered in the documents examined presented challenges in terms of comparison often limiting the potential for

analysis and requiring follow up interviews for clarification. The next phase of the research will explore means of widening the sample as well as expanding it beyond largely non-English speaking countries through a Pan EU survey with inclusion of other relevant international healthcare organisations.

FINDINGS AND DISCUSSION

The review shows that not all the healthcare organisations have adopted performance measurement systems based on KPIs such is the case of Spain, which limited the study to eight healthcare providers. It was also found that in the State of Queensland (Australia) currently there is not a common performance measurement framework. However, prior to the recent transfer of ownership to the District Health Boards the Australian Government required all Hospital and Health Services (HHSs) to spend at least 2.15% of their asset replacement value for the building maintenance, and to report it in conjunction with the planned versus corrective maintenance ratio and the unfunded backlog maintenance liability. At present, these KPIs are still being used by some of the Queensland HHSs and therefore are included for analysis in this research.

Performance characteristics and KPIs

The review reveals that there is not a single set of performance measures uniformly applied for the healthcare estate. Each organisation monitor their estate performance using a set of measures that are driven by individual government and healthcare organisational policies, strategies and goals, and this is influenced also by the shape of their estate portfolios. For instance, the performance measures adopted by NHS England in the Premises Assurance Model (PAM) address the challenges of funding in the future, and are aligned with the NHS Constitution regulatory requirements of ensuring ‘service users are protected against risks associated with unsafe and unsuitable premises'. NHS Scotland primarily focuses are the safety of the patient, to improve efficiency, the physical condition and the quality of the facilities, and reduce underutilise space.

In the case of New South Wales, the performance measures are underpinned to the Health Department's aim of delivering long term benefits through the improvement of the condition of assets, reducing future cost of management and maintenance, and having an estate portfolio aligned with service delivery requirements. In the United States, HHS has the long term goals of ensuring that property inventories are maintained at the right size, cost and condition to support agency missions and objectives. In the case of New Zealand the primary focus is on condition and utilisation as they enable for a more informed asset management practice, and also functionality with a view to providing better investment planning and decision making; or in New South Wales where there is a large interest on addressing poor asset condition and functionality, providing the right services in the right locations with facilities that support efficient and appropriate service provision.

Despite each organisation reflecting their own priorities, the review reveals that there are some similarities in the long term goals, mainly related to improving conditions, functionality, reducing costs and utilisation, with a list of attributes that are commonly assessed and monitored by the greatest number of organisations. These are physical condition, space utilisation, functionality (ability of facilities to support required functions) and measures within the financial perspective relating to operational cost, backlog maintenance (also called deferred maintenance) and maintenance cost. Other attributes identified tended to be only monitored by just one or a limited number of

organisations tending to be specific and reflective of the organisations' strategies, priorities and policies. An example of this would be the percentage of single bedrooms in NHS England which is viewed as an indicator of patient experience which is an important consideration for their patient centred delivery approach. In New South Wales (Australia) the effectiveness of maintenance programmes is assessed as it is viewed by policy makers as the way to achieve a more reliable operation of the assets and reduced incidence of premature failure requiring expensive repair or replacement, thus freeing funds for other purposes. In the United States the ratio of expenditure on maintenance and repair costs to the investment required is measured with a view to avoid shortfalls that are likely to reduce useful life of the facilities degrading the overall performance and causing an increment of long-term costs.

Although these measures have a more strategic focus, there is evidence in the literature for their assessment and monitoring. For example, measuring the effectiveness of maintenance programmes have been supported by Lavy *et al*., (2014); or Tucker and Smith (2008) who stated the need for monitoring patient experiences and customer satisfaction in order to understand the facility's performance from a user's perspective. In general, less attention is given to environmental indicators in the estate performance frameworks as it is normally reported in detail by different departments aligned with other policy priorities. Such as is the case of NHS Scotland who argues that there are very specific requirements for how environmental performance is measured due to its scale and complexity of monitoring. However, authors such as Lavy *et al*., (2014) and Brackertz (2003) included the environmental perspective as a core element for facilities assessment.

Table 2 reflects the similarities and differences among the organisations in terms of the attributes of the estate that each organisation considers in their performance measurement and monitoring frameworks; and table 3 offers a compilation of all the KPIs identified from the review for each attribute.

The following sections describe the performance attributes that are mostly monitored by the healthcare providers reviewed, and the literature opinion on the rational for their consideration.

Physical condition

Physical condition is considered by many authors as a core element for measuring and monitoring estate performance (Lavy *et al*., 2014; Syakima *et al*., 2011). It supports the decision makers to decide whether to continue using or to maintain the assets, to repair deficiencies or even proceed to disposal. Different approaches are used by organisations to assess physical condition, such as to measure it on a scale of good, fair or poor and unsatisfactory (or similar) as it has been proposed by some authors in academia; or through the use of the Facility Condition Index, a standard metric used widely to report physical condition by both organisations and advocated in the literature; although authors such as Lavy *et al*., (2014) employs this indicator to report maintenance efficiency.

Space utilisation

During the last two decades emphasis has been given by many authors for the assessment of space utilisation in facilities. Douglas (1994) listed space utility (identifying under-used and over-used spaces) among ten primary measures for effective evaluation of facility's performance. Wauters (2005) stated that benchmark space use is a prime aspect in facilities management as it drives all the premises costs.

Table 2: List of estate attributes considered by each organisation

	Organisations / Attributes	NHS England	NHS Scotland	NHS Wales	HHS United States	New Zealand	New South Wales (Australia)	Ontario (Canada)	Metro North HHS (Queensland)
Financial	Operational cost	■	■		■	■	■		
	Maintenance cost	■	■		■	■	■		
	Backlog maintenance cost	■	■	■	■				■
	Resource allocation				■				■
	Productivity	■							
Physical	Physical condition		■	■	■	■	■	■	
	Age	■	■						
	Remaining economic live					■			
Safety	Statutory compliance	■	■	■					
	Level of risk associated with outstanding backlog maintenance	■	■	■					
	Fire incidents	■	■						
Functional	Utilisation	■	■	■	■	■	■		
	Surplus					■			
	Available capacity					■			
	Functionality/Functional suitability	■	■	■		■	■		
Patient Experience	Quality of the building		■						
	Single bedrooms	■							
	Patient feedback	■	■						
Environment	Energy performance	■		■	■				
	Water and Waste	■							
	Sustainability				■				
Others	PAMS*Quality		■						
	Organisation Governance	■							
	Daily decision metrics				■				
	Construction programme metrics				■				
	Effectiveness of maintenance programmes						■		■
	Mission Dependency				■				

*Property Asset Management Strategy (PAMS)

For instance, in Australia the HHS identified savings and cost avoidance of over $23 million between 2010 and 2012 through improved utilisation, the associated energy savings, as well as disposal and consolidations (Holland, 2013). Most of the organisations reviewed are working towards the improvement of space utilisation as a means of cost-savings, but it is also a measure to determine whether additional expenditure is likely to meet demand effectively or create surplus stock. How space

utilisation is measured varies among organisations. Different measures are identified through the review, including the required program space vs. the existing space, referred by Lavy *et al*., (2014) as a functional index; but also the percentage of space utilised assessed as proposed by Douglas (1994).

Table 3: List of attributes and KPIs considered by healthcare organisations to evaluate estate performance

Dominions	*Attributes*	*Key Performance Indicators*
Financial	Operational cost (all per sq.m.)	Annual operation cost; Total operating cost; Cleaning cost; Rates cost; Catering cost; Pottering cost per consumer week; Laundry and linen cost per consumer week; Energy cost; Waste cost per consumer week; Facilities management cost; Cost efficiency score
	Maintenance cost	Maintenance cost per sq.m; Total maintenance expenditure by functional area
	Backlog maintenance cost	Backlog maintenance cost per sq.m.; Total maintenance backlog cost/ gross internal area (GIA)
	Resource allocation	Annual Maintenance expenditure as a %Total Replacement Value; Sustain Rate
	Productivity	Adjust Treatment Index (ATI)
Physical	Physical condition	Percentage of the estate to be in excellent or satisfactory condition with evidence of only minor deterioration or above; Facility Condition Index (FCI) or Condition Index (CI); Physical Condition Index
	Age	Percentage of properties less than 50 years old; Percentage of the estate built since 1948; Average age
	Remaining economic live	No KPIs identified
Safety	Statutory compliance	Overall percentage compliance score from SCART*; % of the estate that is required to take action in the current plan period to comply with relevant guidance and statutory requirements
	Level of risk associated with outstanding backlog maintenance	Significant and high risk backlog maintenance as percentage of total backlog expenditure requirement; Total risk adjusted backlog maintenance
	Fire incidents	Number of unwanted (false) fire incident calls/GIA; Number of fire incidents/GIA
Functional	Utilisation	Space utilisation (percentage of properties categorised as fully utilised; building area sq.m per consumer week; % of occupied floor area; percentage of space utilisation; required program space vs. the existing space); Utilisation Index; Usage (Total replacement value/weighted separation; Weighted separation per sq.m.; Asset depreciation/ weighted output measure of service)
	Surplus	No KPIs identified
	Available Capacity	Beds per 1,000 people; Theatres per 10,000 people
	Functional Suitability	Percentage of properties classified as ideal accommodation or very satisfactory; Functional unsuitability (%of occupied floor); Functional Performance Index
Patient Experience	Quality of the building	Percentage of properties categorised as excellent or satisfactory quality in terms of amenity, comfort engineering and design
	Single bedrooms	Percentage of single bedrooms for patients
	Patient feedback	Positive response to patient questionnaire on patient rating of hospital environment; Percentage of positive response for privacy and dignity; Percentage of positive response for cleanness and tidiness; Percentage for positive response for food services
Environment	Energy performance	Total site energy consumed /Heated; Net energy consumption; Carbon Dioxide Emissions/ Occupied floor area; % of the estate with an energy consumption of 410KWh/m2 or less
	Water and waste	Water, sewage and waste carbon indicator
	Sustainability	Sustainability Index (SI)
Others	Property Asset Management Strategy (PAMS) document Quality. KPI: PAMS Quality checklist overall score Organisation governance – No KPIs identified Daily decision metrics Construction programme metrics Effectiveness of the Maintenance Programmes. KPIs: Ratio of Programmed Maintenance to Reactive Maintenance; Backlog maintenance as a % programme maintenance; Total maintenance expenditure/ weighted of separation Mission Dependency – No KPIs identified	

* Statutory Compliance Audit and Risk Tool (SCART)

Functionality

Functionality is the extent to how well the available accommodation supports the delivery of healthcare. To measure and monitor facilities functionality has been recommended by a few authors in academia (Brackertz, 2004; Syakima *et al*., 2011) and some standard bodies such as Australian National Audit Office (2010) that

includes the functionality dimension to evaluate how the asset assists in meeting its program delivery requirements. In healthcare, monitor functionality is highly important due to the advances in the technology and changes in disease trends. In New Zealand functionality is monitored with the intention of supporting the change in the models of care and health services requirements. What elements are considered for assessing functionality vary slightly among organisations and the proposed by some authors. NHS Scotland assesses functional suitability according to three elements, including internal space relationship, support facilities and location in terms of how space is situated in relation to other departments. A similar approach is taken by NSW that assesses functionality in terms of internal fit-out capability, the capacity of the facility, the location and the relative level of amenities required to ensure the efficiency of the operation. Lavy *et al*., (2014) proposed to assess functionality looking at organisational or business mission, space, employees and other support facilities. Talib *et al*., (2013) evaluated functionality in terms of the design, utility and access.

Operation cost, maintenance cost and backlog maintenance cost
Financial measures are important as they provide the current expenses in the facility or organisation. The KPIs used by organisations vary from those proposed by some authors. Most of the organisations measure and monitor backlog maintenance cost as backlog cots /m2, whereas some authors focus more in the efficiency of the maintenance programmes, such as Lavy *et al*., (2014) that use the maintenance efficiency indicator (MEI) that is the ratio of spending percentage on deferred maintenance (SDM) to the Current Value. This has been considered as the most influential performance indicator that could significantly affect the strategic decision making in an organisation (Lavy *et al*., 2014).

CONCLUSION

Similarities are observed in the performance attributes and KPIs considered by and among healthcare providers for estate performance measurement and monitoring which are common to most providers, such as physical condition, utilisation, functionality, operation cost, backlog maintenance and maintenance cost; but also variations, as some of the measures that are meaningful for some organisations are not for others, driven by government priorities, policies, organisations goals. The review also shows that there are some differences in the set of core attributes and KPIs established by authors in the literature, and the elements for assessment.

This research asks whether it is possible to establish a common framework representing a core set of attributes and KPIs to be used for strategic management and planning for healthcare estates which can encourage healthcare organisations to align with international best practice. Despite the potential theoretical contribution offered, there is a need to explore the value of its application, as there is no single, best set performance measures suitable for every healthcare provider. Each of the healthcare providers monitor and develop its own set of measures based on its organisational structure, goals and with consideration of the data already in place. However, the authors believe that there is a set of core attributes that should be measured and monitored by all the healthcare providers to obtain the best value of the estate relying on international best practices.

REFERENCES

Amaratunga, D and Baldry, D (2002) Moving from performance measurement to performance management. *Facilities*, **20**(5/6), 217-223.

Australian National Audit Office (ANAO) (2010) Strategic and Operational Management of Assets by Public Sector Entities: Delivering agreed outcomes through an efficient and optimal asset base.

Bassioni, H A, Price, A D F and Hassan, T M (2004) Performance measurement in construction. *Journal of Management in Engineering*, 20(2), 42-50.

Brackertz, N (2004) A framework for the strategic management of facilities, balancing physical and financial considerations with service, customer, utilisation and environmental requirements. *In*: *10th Pacific Rim Real Estate Conference: International Property Investment, 25-28 January 2004, Windsor Suite Hotel, Bangkok, Thailand*.

Douglas, J (1994) Developments in appraising the total performance of buildings. *Structural Survey*, **12**(6), 10-15.

Fitzgerald, L, Johnston, R, Brignall, S, Silvestro, R and Voss, C (1991) *Performance Measurement in Service Businesses; CIMA Research Series*. Cambridge: Black Bear Press Ltd.

Hinks, J and McNay, P (1999) The creation of a management-by-variance tool for facilities management performance assessment Facilities, **17**(1/2), 31-53.

Holland, E J (2013) *Saving Taxpayer Dollars: Freezing the Federal Real Estate Footprint*. U.S Department of Health and Human Services (Testimony)

Lavy, S, A Garcia, J and K Dixit, M (2014) KPIs for facility's performance assessment, Part II: identification of variables and deriving expressions for core indicators. *Facilities*, **32**(5/6), 275-294.

Lavy, S, Garcia, J A and Dixit, M K (2010) Establishment of KPIs for facility performance measurement: Review of literature. *Facilities*, **28**(9/10), 440-464.

Lavy, S and Shohet, I M (2007) A strategic integrated healthcare facility management model. *International Journal of Strategic Property Management*, **11**(3), 125-142.

Meng, X and Minogue, M (2011) Performance measurement models in facility management: A comparative study. *Facilities*, **29**(11/12), 472-484.

Pullen, S, Atkinson, D and Tucker, S (2000) Improvements in benchmarking the asset management of medical facilities. *In*: *Proceedings of the International Symposium on Facilities Management and Maintenance,* Brisbane, Australia, 265-71.

Purbey, S, Mukherjee, K and Bhar, C (2007) Performance measurement system for healthcare processes. *International Journal of Productivity and Performance Management*, **56**(3), 241-251.

Shohet, I M (2006) Key performance indicators for strategic healthcare facilities maintenance *Journal of Construction Engineering and Management*, **132**(4), 345-352.

Shohet, I M (2010) Community Clinics. *In*: M Kagioglou and P Tzortzopoulos (Eds.) *Improving Healthcare through Built Environment Infrastructure*. Oxford, UK: Wiley-Blackwell, 249-266. doi: 10.1002/9781444319675

Steinke, C, Webster, L and Fontaine, M (2010) Evaluating building performance in healthcare facilities: an organizational perspective HERD: Health Environments. *Research & Design Journal*, **3**(2), 63-83.

Syakima, N, Sapri, M, and Shahril, M (2011). Measuring performance for classroom facilities. *International Conference on Sociality and Economics Development*, **10**, 209-213.

Talib, Y, Yang, R J and Rajagopalan, P (2013) Evaluation of building performance for strategic facilities management in healthcare: A case study of a public hospital in Australia. *Facilities*, **31**(13/14), 681-701.

Tucker, M and Smith, A (2008) User perceptions in workplace productivity and strategic FM delivery. *Facilities*, **26**(5/6), 196-212.

Wauters, B (2005) The added value of facilities management: Benchmarking work processes. *Facilities*, **23**(3/4), 142-151.